Ground Beetles Fauna of Scrub Forests of Chakwal Division, Punjab

BASELINE ESTABLISHMENT FOR PRERAH, DILJABBA AND ARA RESERVE FORESTS

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ABSTRACT

The study was conducted to establish baseline for Sustainable Forest Management Project (SFMP) in three scrub forests of Chakwal Division namely, Parerah Reserve Forest; Diljabba Reserve Forest and Ara Reserve Forest from 17th to 24th October 2017. Carabid beetles were captured by using different techniques including active hand searching of ground (the underside of stones, rocks, leaf litter and tree bark), pitfall traps and UV light traps. A total of 126 specimens belonging to 21 species were collected – Prerah Reserve Forest 52 specimens (8 species); Diljabba: 10 specimens (5 species) and Ara Reserve Forest 64 specimens (14 species). The most abundant species was *Chlaenius (Chlaeniostenus) nitidicollis* Dejean, 1826 (116 specimens) and frequently encountered at Prerah and Ara Reserve Forest. The most carabid species diverse site was having highest Simpson Diversity Index (0.79) and Shannon Diversity Index (1.99) score for Ara Reserve Forest. The current baseline will help in monitoring the impact of SFMP activities on Carabidae fauna of the study area.

INTRODUCTION

The word Carabidae (ground beetles) is derived from a new Latin word *cārabus* which means spiny lobster or a horned beetle (Quinion, 2011). Majority of Carabids are the generalist predators (feed on wider variety of organisms), there are a number of groups that have become specialized predators (feed on specific type of organism) e.g., Peleciini and Promecognathini on millipedes, Cychrini and Licinini on snails. A few clade have larvae that are ectoparasitoids on other arthropods e.g., Lebiini, Brachininae, and Peleciini. Others are seed-eaters e.g., Harpalini (Maddison, 2006). A review of 110 studies reveals that 241 species of adult carabids predate on different insectpests. Among these Carabids reviewed 43% were predating on Lepidoptera, 20% on Diptera, 12% on Coleoptera and 12% on Homoptera (Sunderland, 2002).

Ground beetles are recorded on most terrestrial habitats in all continents. They are mostly nocturnal and polyphagous predators, although some are diurnal or phytophagous (Larochelle, 1990). Most ground-beetles live on the surface of the ground, while some species live in the soil (e.g., Anillina), in caves (e.g., Trechini, Harpalini), or on the vegetation (e.g., Zolini, Lebiini).

Ground beetles are sensitive to their environment. They demonstrate a flexible set of responses to both abiotic and biotic factors. Therefore, these beetles are commonly used as bioindicators to assess the biodiversity of ecosystems, indicate the impact of landscape changes, evaluate environmental health, predict the effect of climate changes, classify habitats for nature protection and characterize soil-nutrient status in forestry. They can also be used to control pest invertebrates (e.g., Lepidopteran caterpillars). In the future, ground-beetles may become more commonly used in biological and integrated programs, e.g., as natural control agents of noxious invertebrates, especially soil insect pests, or control agents of weeds, especially their seeds (Larochelle and Larivière, 2003).

The Carabidae fauna of Pakistan is poorly known and particularly about study area. Various faunal studies have been published from Pakistan, namely those by Andrewes (1929,

1935); Jedlicka (1963), Kirschenhofer (1998, 1999, 2009, 2010 and 2014); Rahim et al. (2013); Kazi et al. (2016), Khatri et al. (2016), Ullah et al. 2017, Anichtchenko & Kirschenhofer (2017), Azadbakhsh (2017) and Azadbakhsh & Rafi (2017). Therefore, current baseline study will help in discovering Chakwal Scrub Forests Carabid fauna for Sustainable Forest Management Project.

FIELD COLLECTION METHODOLOGY

***Pit fall trapping*:** This method is a frequently used to collect ground surface moving insects. Pitfall trapping is a "passive" sampling method where the activity of the target organism is necessary for capture (see Figure 1). A pitfall trap is a container placed into the soil. Its rim is usually leveled with the soil surface. The trap 1/3 bottom is filled with an attractant or killing/preserving liquid (ethanol + vinegar). Therefore, ground moving insects are fall into it and get drowned and killed. Traps was monitored after every 24 hours. Captured samples was emptied in to a bottle with field label and traps will be refilled again.

***Hand searching on the ground*:** Hand collection involved active searching for the beetles on the ground, under logs, stones, rocks and leaf litter. Beetles were sampled by manual searching under logs, stones and tree barks etc. These beetles were caught using an aspirator or a pair of forceps measuring 12 inches. This technique were implemented both during the day and at night time collection.

***Ultra Violet Light Trapping*:** UV light trap was used to collect insect during night time. This trap was operated for one hour after sunset. Nocturnal insects were attracted to UV light and trapped through funnel inside bottle in killing agent and preservative (75% Ethanol).

***Preservation*:** Adults were preserved in 75% ethanol during field work. All specimens were labeled with the locality name (geographical coordinates such as latitude and longitude), collection date, collector's name, and biological data (e.g., general habitat and microhabitat). All visited sites, co-ordinates, temperature, humidity and altitude were noted in field book.

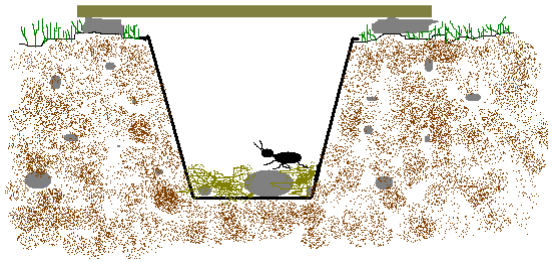

Figure 1: Pitfall trap

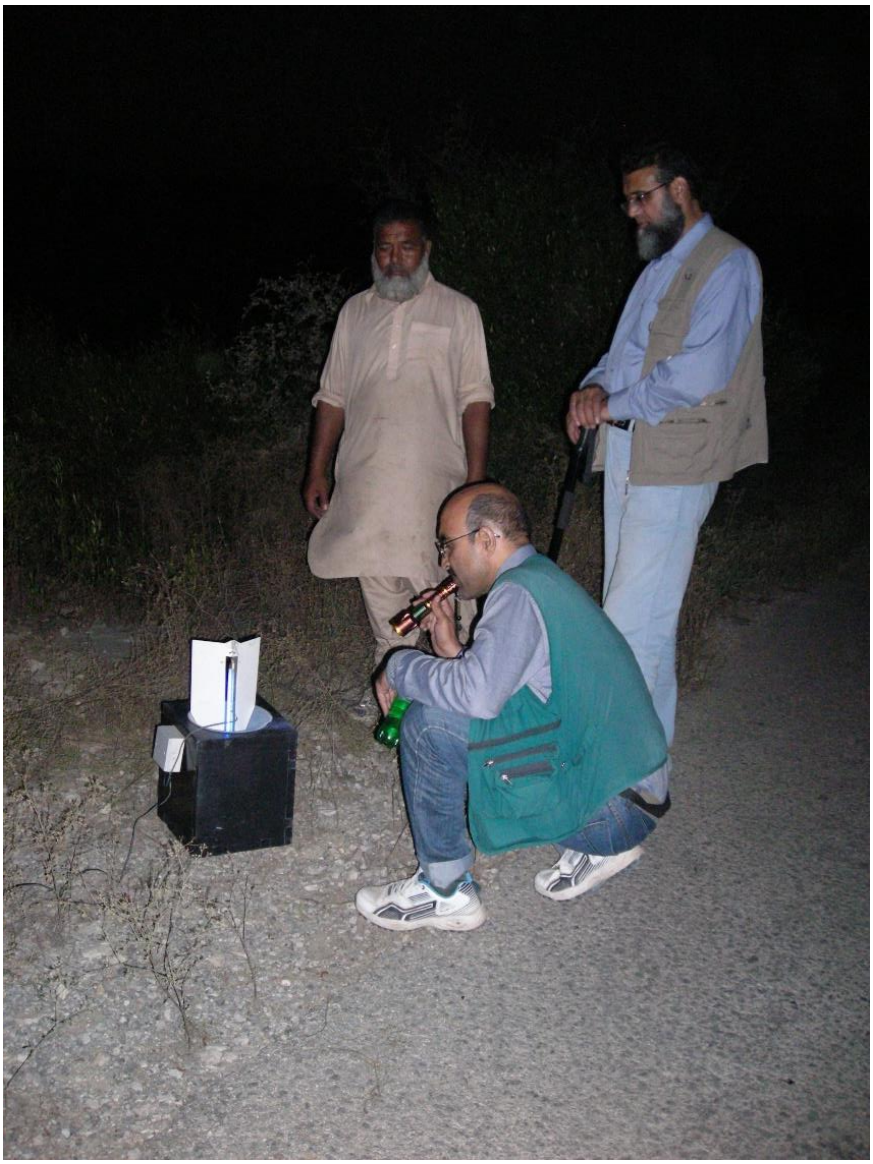

Figure 2: Ultra Violet Light Trap

LABORATORY WORK & DATA PRESENTATION

Identification: All collected Carabidae specimens were identified at Insect Repository Pakistan Museum of Natural History Islamabad, using diagnostic key and already published regional work particularly by Andrewes (1929, 1935), Jedlicka (1963), Mandl (1964), Hrdlička (2003), Rahim et al. (2013); Kazi et al. (2016), Khatri et al. (2016), Ullah et al. 2017, Anichtchenko & Kirschenhofer (2017), Azadbakhsh (2017) and Azadbakhsh & Rafi (2017).

Table 1: Sampling sites visited for Carabid collection

Station	Site	Date	Coordinate
S1	Pharera nr. Coal Mine	19.x.2017	N 32.779920, E 73.144871 N 32.779239, E 73.145618 N 32.778471, E 73.146316
S2	Pharera, R.F. Naiyan Wala Bund	19.x.2017	N 32.760924, E 73.145379 N 32.763720, E 73.147765 N 32.765608, E 73.150582
S3	Dil Jabba, R.F., Pirqad	21.x.2017	N 32.89876, E 73.15497 N 32.897926. E 73.152845 N 32.897062, E 73.151859
S4	Dil Jabba South End	22.x.2017	N 32.828784, E 73.090391 N 32.830075, E 73.091751 N 32.831297, E 73.094282
S5	Arrah Tercha	23.x.2017	N 32.731554, E 73.179211 N 32.730856, E 73.173983 N 32.728420, E 73.170549
S6	Arrah, Sakhi Nullah (Sikkiwala Kas)	24.x.2017	N 32.784320, E 73.199682 N 32.786046, E 73.200754 N 32.791470, E 73.200645

Data display: The data were presented in the form of number of individuals. There are several numerical indices in use, which quantitatively describe the different level of diversity and evenness in sample collected from different localities of an area (Simpson, 1949, Hammer *et al.,* 2001, Magurran, 2004). These commonly used diversity indices are given below with their formulae.

- Shannon Diversity Index = H = – Σsi (pi) (loge pi)
- Shannon index of Evenness = H / loge (*S*)
- Simpson Index of Dominance = D = Σ ni (ni – 1) / *N* (*N* – 1)
- Simpson Diversity Index = 1– D = 1 – Σ *ni* (*ni* – 1) / *N* (*N* – 1)

The description of symbol used in above formulae are given below

- *N* = the total number of individuals in the sample
- N = not italic is used for Hill's numbers)
- *S* = the number of species in the sample.
- *ni* = the number of individuals of species *i* in the sample, Σ *ni* = *N.*

- *pi* = the proportion of individuals of species *i* in the sample, *pi* = *ni*/*N.*
- loge = ln = natural log

Diversity indices were analyzed by using PAST software and displayed through bar chart column comparing different values between different wild life parks.

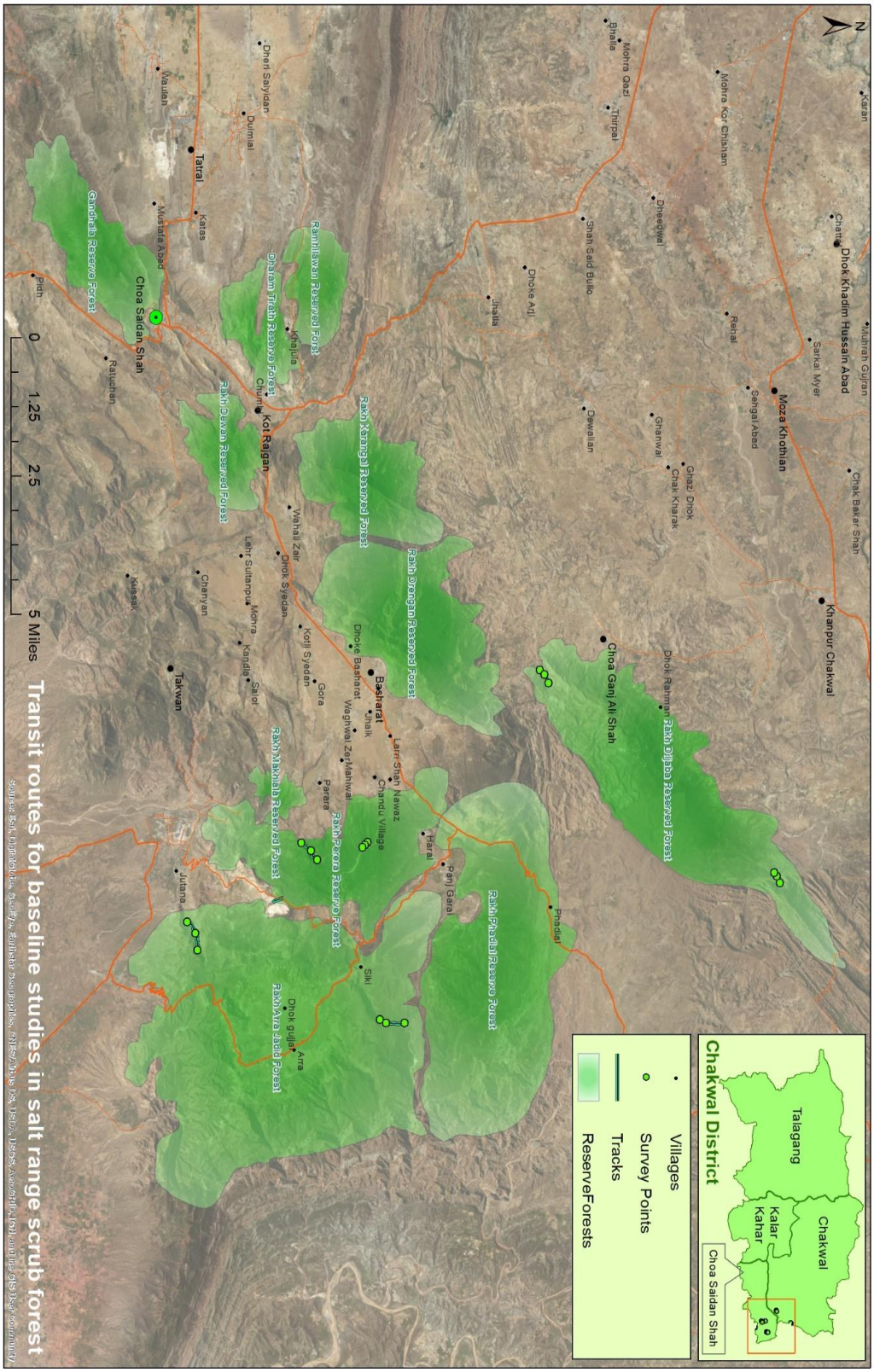

Figure 3: Map of sampling sites at Scrub Forest Chakwal

RESULTS & DISCUSSION

Carabids (ground beetles) were mainly collected through direct sampling by active searching of undersides of stone, rocks tree barks of different macro habitats. The study resulted in collection of 21 ground beetle species that belongs to 7 subfamilies, 11 genera, 14 subgenera (Table-2). Among forests highest richness of ground beetles were recorded in Ara 14 species followed by Prerah 8 spices and Diljabba 5 species. The highest richness was recorded in subfamily Licininae represented by 9 species and lowest richness were recorded in subfamily Broscinae represented by one species. Two species *Orthrotrichus cymindoides* and *Broscus (Broscus) punctatus* were recorded from all forests under consideration. Following species has been recently reported by some authors, Azadbaksh & Rafi 2007 reported *Chlaenius (Nectochlaenius) nigripennis* (Babusar Pass, Mansehra), *Broscus punctatus* (Kohat and Chitral), *Distichus* (*Distichus*) *platyops* (Chitral), *Scarites (Parallelomorphus) indus* (Narowal and Bausar Pass), *Pheropsophus (Stenaptinus) catoirei* (Talagang, Uchali, Jacobabad) *Pheropsophus* (*Stenaptinus*) *hilaris* (Talagang and Jhalar Lake-Khushab), *Chlaenius* (*Chlaeniostenus*) *pulcher* (Ghalar Lake, Kushab); Mishkat *et al*., 2017 reported *Pheropsophus (Stenaptinus) catoirei* (Attock, Islamabad, Rawalpindi, Chakwal, Choa Saidan Shah, Khusab, Layyah, Chitral, Swat, Dir, Mansehra, Ghizer, Chilas, Dassu, Muzafferabad, Rawalakot, and neelum Valley), *Pheropsophus* (*Stenaptinus*) *hilaris* (Chakwal and Rawalpindi); Khatri et al., 2016 reported *Pheropsophus (Stenaptinus) catoirei*, *Chlaenius (Pachydinodes) hamifer* and *Chlaenius (Epomis) nigricans* from Panjgor-Balochistan.

Diversity indices results (Figure-4) indicated that dominance score was higher 0.44 at Parerah because of highest abundance of single species *Chlaenius (Chlaeniostenus) nitidicollis* (65% of assemblage at Parerah). Therefore, Arrah Reserve Forest is the most diverse site. Its score is little different from Diljabba as a result of *Chlaenius (Chlaeniostenus) nitidicollis* (35% of assemblage at Arrah). Shanon Weiner diversity score Arrah is higher because of higher richness but its evenness score is less than Dajabba Reserve Forest where carabids species abundance was highly even.

Most of the Scrub forest ground beetles fauna were found along bank of ephemeral streams, check dam (around its bank and downstream seepage promoted vegetation), stones under shrubs and trees canopy. The subfamily Licininae, Brachininae and Cicindelinae individuals were collected along the banks of ponds, springs, streams and ephemeral streams. Subfamily Scaritinae and Broscinae individuals were collected under stone and rock with sandy soil laying in open area, fields and meadows. Subfamily Pterostichinae and Platyninae individuals were collected under stones and rocks laying in shady damp moist places. Human induced perturbation including, grazing, coal mining activities (solid waste, contaminated water discharge and labor activities), cement industry limestone queries, sandstone and Chakwal stone mining are destroying habitat. These activities are effecting habitat of cryptozoic fauna including Carabidae.

Table 2: Checklist of Carabid Beetles belonging to Chakwal Scrub Forests along with number of individual at each forest

Sr. No.	Species	Subfamily	Parerah R.F	Diljabba R.F.	Arrah R.F.
1	*Chlaenius (Chlaeniostenus) nitidicollis* Dejean, 1826	Licininae	34		23
2	*Chlaenius (Rhopalopalpus) janthinus* L.Redtenbacher, 1844	Licininae	5		
3	*Chlaenius (Chlaeniostenus) pulcher* Nietner, 1857	Licininae		2	
4	*Chlaenius (Chlaeniellus) laeviplaga frater* Chaudoir, 1876c: 261	Licininae		2	16
5	*Chlaenius (Epomis) nigricans* Wiedemann, 1821: 110	Licininae			3
6	*Chlaenius (Pachydinodes) hamifer* Chaudoir, 1857	Licininae			1
7	*Chlaenius (Chlaeniellus) flavipes* Menetries, 1832	Licininae			1
8	*Chlaenius (Nectochlaenius) nigripennis* Chaudoir, 1856	Licininae			2
9	*Diplocheila (Isorembus) cordicollis* Laferte 1851	Licininae	2		
10	*Distichus (Distichus) platyops* (Andrewes, 1932)	Scaritinae			1
11	*Scarites (Parallelomorphus) indus* G.A.Olivier, 1795	Scaritinae	2		
12	*Abacetus guttula* Chaudoir, 1869	Pterostichinae	3		
13	*Abacetus (Caricus) politus* Chaudoir, 1869	Pterostichinae			2
14	*Trigonotoma indica* Brulle, 1834	Pterostichinae			1
15	*Brachinus* sp.	Brachininae			2
16	*Pheropsophus (Stenaptinus) catoirei* (Dejean, 1825)	Brachininae			4
17	*Pheropsophus (Stenaptinus) hilaris sobrinus* (Dejean, 1826)	Brachininae			1
18	*Calathus (Neocalathus) kollari* Putzeys, 1873	Platyninae	2		
19	*Orthotrichus cymindoides* (Dejean, 1831)	Platyninae	3	1	3
20	*Cicindela (Calomera) chloris* Hope, 1831	Cicindelinae		3	
21	*Broscus (Broscus) punctatus* (Dejean, 1828)	Broscinae	1	2	4
Abundance			52	10	64
Richness			8	5	14

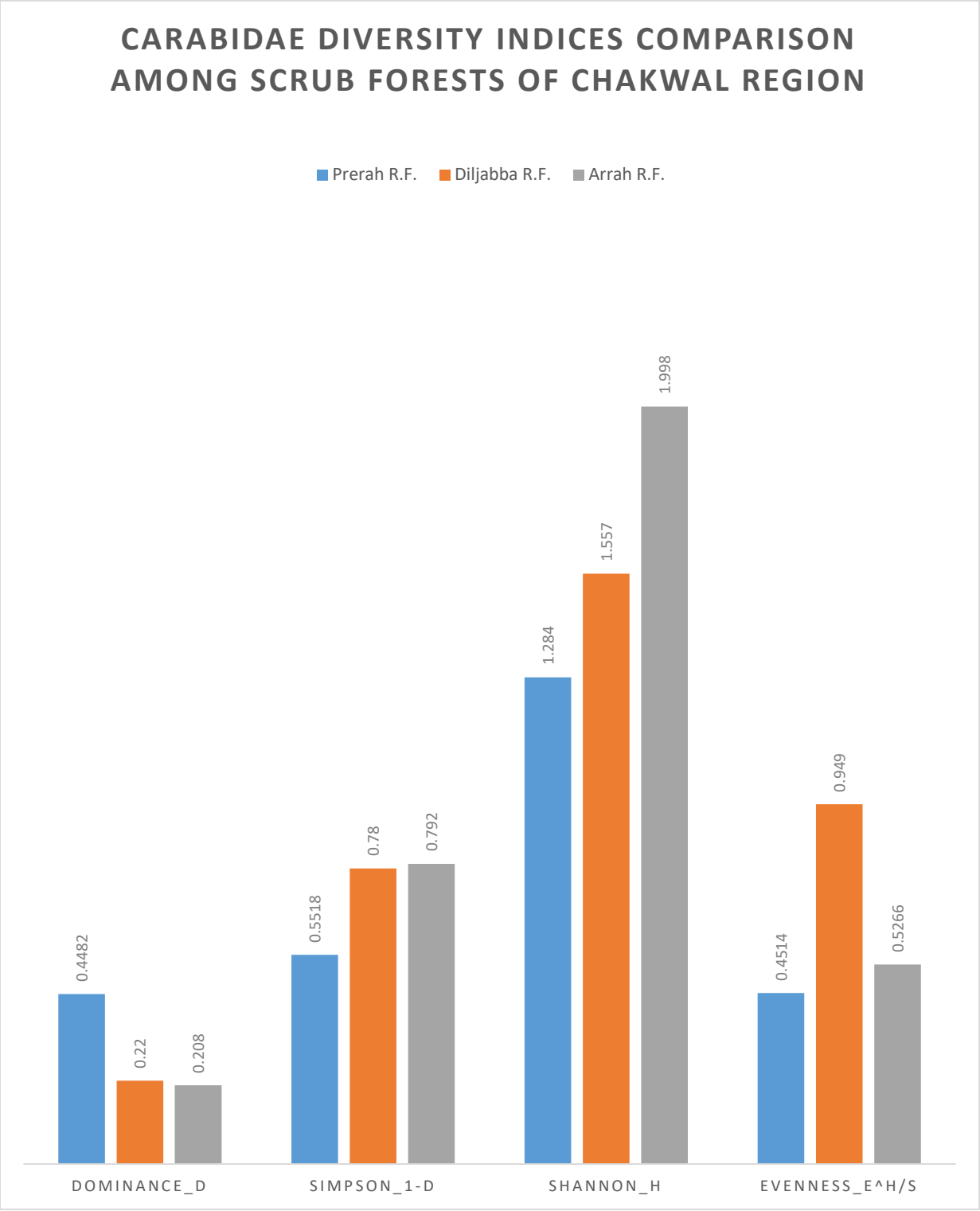

Figure 4: Diversity indices comparing Carabid fauna of Prerah, Diljabba and Ara Reserve Forests

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